assumed to be infected by sclerotia each year. Another favoring condition was an unusually rainy season, April, May, and June being very wet.

The same month (July) I carefully examined a number of large rye-fields in the central part of the State, where the spring was also wet, but where rye is not commonly cultivated, nor ever twice in succession on the same field, the result being that I could not find a single sclerotium.

It would be interesting to know whether ergot was abundant in other parts of the country, particularly along the Atlantic coast, where the rainfall was very heavy, 1889 being one of the wettest seasons on record.

AN EXPERIMENT IN THE TREATMENT OF BLACK-ROT OF THE GRAPE.

By B. T. Galloway.

Despite the fact that black-rot has ravaged the vineyards of this country for more than a quarter of a century, no systematic attempt, aside from bagging the fruit, was made to combat it until within the past three years. It is true that numerous "remedies" were proposed for the disease, but in no case had any of them stood the test of a thorough trial.

Bagging the fruit as a means of preventing rot first began to be extensively practiced something like ten or a dozen years ago, and there is no doubt that when properly done it is still the safest and most trustworthy means of saving the fruit. The only drawback to bagging is the cost, which must necessarily be considerable, as each bunch, in order to be made secure, is first bagged, then the bag is fastened, and finally, when the fruit is gathered, the bags must be removed. All of this of course consumes time, and time is money in this case as well as in any other. Where a man has a few choice varieties that he wishes to preserve for table use it would probably pay him to bag the fruit; but if he is a large grower, using his crop for wine, the impracticability of such a plan will at once become apparent.

At the time bagging first began to be practiced, grape-growers, as a rule, recognized the fact that black-rot was a fungous disease, due to outside influences, and not brought about by any morbid conditions of the plant. At first it was the practice to put on the bags as soon as the first rot specks appeared; but experience soon demonstrated that to preserve the fruit it was necessary to inclose the clusters shortly after the flowers opened.

In order to settle definitely the cause of rot and if possible to provide a remedy, this Department began an investigation of the subject in 1886. It is not necessary here to go into the details of this work, it being sufficient for our purpose to say that it was proved beyond question that the malady was caused by a parasitic fungus growing within

the tissues of the berry, that this parasite was propagated by minute spores which were at all times present in the vineyard only awaiting suitable conditions of moisture and heat and contact with the growing fruit to cause infection. These facts once demonstrated it was readily understood why bagging prevented the rot, as by that process the spores were simply excluded and infection thereby made impossible. Having reached this stage of the investigation, the question arose as to whether there was not some substance or substances which if applied to the fruit would prevent the spores from germinating or destroy them entirely, thereby preventing infection in practically the same manner as with the bags.

The questions to be considered in this connection were numerous and difficult of solution. It was necessary that the substance employed should not injure the fruit or foliage, that it should be cheap, easily applied, and above all things practicable, and, finally, that it should not render the fruit unfit for eating or wine-making. The good results obtained in treating mildew with the sulphate of copper compounds was a sufficient reason for giving these preparations a thorough trial for black-rot. Accordingly the first systematic experiments, made with a view of determining the value of the copper remedies for the disease, were undertaken in the summer of 1887. The experiments were made over a very wide area, and, while the results were by no means conclusive, they were of such a nature as to warrant a further continuance of the treatment.

In 1888 the experiments were repeated on a more extended scale, and as a result it was demonstrated beyond question that in a favorable or even ordinary season from 40 to 60 per cent. of the crop could be saved from rot. These trials also showed that of all the preparations used the Bordeaux mixture, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water, yielded the best results. It was further demonstrated that the applications to be successful must be applied *early;* in fact this was to be expected from what was already known concerning the proper time for bagging the fruit.

This year among other things we planned an experiment designed to throw some additional light on a number of questions in connection with the treatment of black-rot; chief among them were the following:

(1) A comparison of the actual cost and results of the treatment, using the preparations known as eau celeste, Bordeaux mixture, and the ammoniacal solution of carbonate of copper.

(2) The proper strengths of the preparations, i. e. the strength which would give the best results.

(3) The proper time to apply the remedies.

(4) The effect of winter treatment, *i. e.* spraying the vines before the leaves start.

The vineyard selected for the work was situated near Eastham, Va., and was the property of Mr. A. L. Holladay, who, it is proper to state,

conducted all the experiments from beginning to end. The vineyard, of about 2½ acres, contained something over 1,400 Norton vines, these being in their tenth year. This area was divided into sixteen sections; but as two of these were treated with remedies with which we are not at present concerned, they will be omitted altogether. The fourteen sections were treated as follows:

Section 1.—Bordeaux mixture *a*, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water.

Section 2.—Eau celeste, containing 1 pound of sulphate of copper, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 3.—No treatment.

Section 4.—Bordeaux mixture *b*, containing 4 pounds of sulphate of copper, 2 pounds of lime, and 22 gallons of water.

Section 5.—Eau celeste *b*, containing 2 pounds of sulphate of copper, 2 pounds of carbonate of soda, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 6.—No treatment.

Section 7.—Ammoniacal solution of carbonate of copper, containing carbonate of copper 3 ounces, aqua ammonia 1 quart, water 22 gallons.

Section 8.—Bordeaux mixture *a*, applied in a different part of the vineyard from section 1.

Section 9.—No treatment.

Section 10.—Bordeaux mixture *b*, applied in a part of the vineyard remote from section 4.

Section 11.—Bordeaux mixture *a*, applied some distance from 1 and 8.

Section 12.—Bordeaux mixture *c*, containing copper two pounds, lime 1 pound, water 22 gallons.

Section 13.—Ammoniacal solution of carbonate of copper applied at some distance from section 7.

Section 14.—Bordeaux mixture *d*, containing 3 pounds of sulphate of copper, 1 pound of lime, and 22 gallons of water.

Sections 10 and 11.—Were treated in March with a simple solution of sulphate of copper, 1 pound of the copper to 25 gallons of water.

With the exception of 8 all the sections were sprayed the first time on May 18, the second on June 3, third on July 23, fourth on August 3, and fifth on August 16. Section 8 received its first application on the 6th of June, this being the experiment designed to test the effect of late spraying. On the 1st of October the fruit on all the sections was gathered and carefully weighed, with the following results:

Section.	No. of vines.	Total yield.	Average yield per vine.	Section.	No. of vines.	Total yield.	Average yield per vine.
		Pounds.	*Pounds.*			*Pounds.*	*Pounds.*
1	120	307¾	2.56	8	92	158¼	1.72
2	122	393½	3.22	9	17	17	1
3	20	20	1	10	146	470	3.21
4	163	357¾	2.19	11	165	574	3.48
5	99	236¾	2.39	12	23	52	2.26
6	21	11¾	.56	13	108	159	1.48
7	108	159	1.48	14	114	336	2.94

Now, in regard to the cost, the chemicals were all purchased at wholesale rates, as follows:

Sulphate of copper	per pound	$0.06½
Best lime	per barrel	1.25
Aqua ammonia	per pound	0.05
Carbonate of copper, concentrated solution	per quart	0.16⅔

Using the Japy pump and Vermorel nozzle, it is estimated that the cost of labor in applying the remedies was $2.50 per acre for five applications, or one half a cent per vine. The number of gallons of the various solutions used per acre was, on an average, 44. Taking these figures as a basis, we have the total cost of treating the various sections as follows:

Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.	Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.
			Cents					*Cents*	
1	120	$1.61	1.3	$6.70	8	92	$1.23	1.3	$6.70
2	122	.95	.8	4.90	9	Proof.	.....	.....	.....
3	Proof.	.....	.....	.....	10	146	1.47	1.0	5.29
4	163	1.71	1.0	5.25	11	165	2.23	1.3	6.70
5	99	1.15	1.2	5.80	12	23	.17	.8	4.00
6	Proof.	.....	.....	.....	13	108	.90	.8	4.00
7	108	.90	.8	4.00	14	114	1.04	.9	4.55

It is seen from the foregoing tables that the largest yield per vine (3.48 pounds) is in section 11, where the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime, was used. This section also received the winter treatment. By comparing this yield with that of section 1, where the same mixture was used but the winter treatment omitted, it is seen that there is a gain in favor of the winter-treated section of nearly a pound per vine. Now examine the figures in section 4, treated with the Bordeaux mixture, containing 4 pounds of copper

sulphate and 2 pounds of lime, and it will be seen that the yield per vine is 2.19 pounds. In section 10, treated in exactly the same way, with the addition of one winter spraying with the simple solution of sulphate of copper, the yield is 3.21 pounds, a gain of more than a pound per vine. This certainly indicates that the winter treatment in this case resulted beneficially, but whether the same will hold true everywhere we are not prepared to say. Assuming that it does, however, let us, on the basis of the figures here given, estimate the cost of treating an acre of vines and compare the yield with that of an acre not treated.

Let us suppose that A owns a vineyard of 1 acre and that his neighbor, B, is the possessor of a similar number of vines of the same variety. A treats his vineyard six times, as follows:

March 20, sprayed with a simple solution of sulphate of copper, 1 pound to 25 gallons, at a total cost of 65 cents. May 18, June 7, July 23, August 5, and August 16, sprayed with the Bordeaux mixture, containing 6 pounds of sulphate of copper, 4 pounds of lime to 22 gallons of water, at a total cost of $6.70, which, upon adding the 65 cents for first spraying, becomes $7.35.

B makes no treatment whatever, consequently saves the $7.35. A's vineyard of 500 vines yields 3½ pounds per vine, or 1,750 pounds for the whole, which, at 3 cents per pound, equals $52.50.

B's vineyard yields 500 pounds, or 1 pound per vine, valued at 3 cents per pound, or, for the whole, $15. Summing up the results we have the following:

A.

By treatment of vineyard	$7.35
Yield of grapes, 1,750 pounds, at 3 cents per pound	52.50
Balance	45.15

B.

No treatment.	
Yield of grapes, 500 pounds, at 3 cents per pound	15.00
Difference in favor of A	30.15

Turning again to the table we notice that section 2, treated with eau celeste containing 1 pound of copper sulphate and 1½ pints of ammonia to 22 gallons of water, yielded 3.22 pounds per vine. This is indeed a very good showing, but as this preparation, unless used with extreme caution, is certain to burn the foliage its use can not be advised.

The conclusions which we draw from the foregoing may be briefly summed up as follows:

(1) It pays to treat the vines for black-rot.

(2) The best preventive, all things considered, is the Bordeaux mixture, containing 6 pounds of copper sulphate, 4 pounds of lime to 22 gallons of water.

(3) As the amount of copper in the Bordeaux mixture is decreased its value as a preventive is lessened.

(4) The application of the Bordeaux mixture should in all cases begin early, *i. e.*, about the time the flowers are opening.

(5) Spraying the vines before the leaves start with the simple solution of sulphate of copper is decidedly beneficial.*

ERYSIPHEÆ UPON PHYTOPTUS DISTORTIONS.

By F. W. Anderson and F. D. Kelsey.

Dr. Byron D. Halsted's note on *Sphœrotheca* on Phytoptus distortions in the September Journal is interesting, and concludes by asking; "Have other Phytoptus growths been found infested with members of *Erysipheœ?*" So far as observations on the subject go in Montana an affirmative answer might be returned. In the article on Montana *Erysipheœ* in this number of the Journal by one of the writers, mention is made of *Sphœrotheca Castagnei*, Lév. on *Shepherdia argentea* (Bull or Buffalo Berry), on *Geranium incisum*, and on *Erigeron Canadense;* also of *Sphœrotheca mors-uvœ*, (Schw.) B. & C. on *Ribes rotundifolium;* the former fungus on *Shepherdia* and the latter fungus on *Ribes* were associated with the mites, and the peculiar powdery coating caused by these creatures in places almost covered the fungus. In both cases the distorted leaf axils, abnormally developed buds, and thickened brittle upper leaves bore the perithecia of largest size and in greatest numbers, leading us to the same natural conclusion as was formed in the mind of Dr. Halsted regarding the benefit received by the fungus through the unusual softening of the host tissues. Like him, too, we observed that on those portions of the host unaffected by the mite the fungus was only in an ordinary degree of development for that time of the year [July 10 for *S. Castagnei*, Lév., and June 8, or 9, for *S. mors-uvœ*, (Schw.) B. & C.]

On the *Geranium incisum* occurred also some mite together with the *S. Castagnei*, Lév., and again the fungus seemed to be more richly developed on the doubly affected parts. Late in the season the same fungus was found on *Erigeron Canadense*, and growing side by side with this host were plants of *Epilobium coloratum* badly affected by a mite, and the conidial form of an *Erysipheœ* which seemed to be *Sphœrotheca Castagnei*, although no positive determination could be reached. On *Oxytropis Lamberti*, *Astragalus triphyllus*, and *Astragalus adsurgens*, *Erysiphe communis*, (Wallr.) Fr., has been frequently seen in company with a mite; while *Erysiphe cichoracearum*, DC., may be found at almost any time during the summer in connection with mites on *Chrysopsis villosa*, *Helianthus* (several species), *Cnicus undulatus*, *Erigeron macranthus*, and *Mertensia Sibirica*. In every case where these forms of animal

*Applicable only to this experiment.